

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 1 005 835 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.06.2000 Bulletin 2000/23

(51) Int. Cl.⁷: A61B 8/12, A61B 8/08

(21) Application number: 99119034.9

(22) Date of filing: 29.09.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

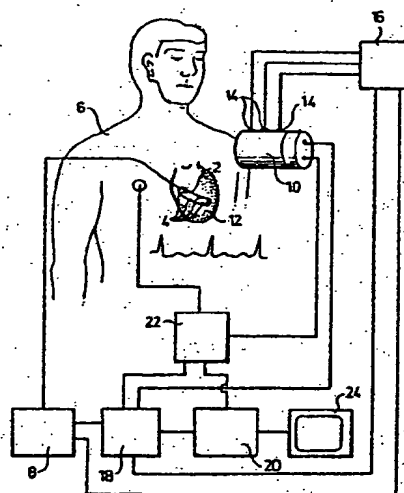
(30) Priority: 01.12.1998 SE 9804147

(71) Applicant: Siemens-Elema AB
171 95 Solna 1 (SE)

(72) Inventor: Ubbby, Johan
West Port, CT 06880 (US)

(54) System for three-dimensional imaging of an internal organ or body structure

(57) A system for 3-dimensional imaging of an internal organ (12) or body structure of a patient (6), comprising an ultrasound probe (10), equipped with localization sensors (14) intended for application to the exterior of the patient in order to generate an ultrasonograph of the organ or body structure. A localization unit (16) is arranged to determine the position of the probe in relation to a reference (2, 4), and an image generation unit (18) is arranged to generate a three-dimensional image of the organ from a plurality of ultrasonographs taken with the probe in different positions and from associated information from the localization unit on the probe's position. At least one moveable reference sensor (4) is devised to be placed in a fixed position in relation to the said organ or body structure to be visualized in order to form the said reference.



EP 1 005 835 A1

detail of the three-dimensional image obtained.

[0024] Since a detailed three-dimensional image of the heart can be obtained quickly and simply in this way, direct study of e.g. the movements of heart valves, and simple introduction of e.g. catheters for imaging, ablation, pressure measurement etc. become possible, and the catheters can be advanced to the exact position desired with no need to move the reference catheter and no need for fluoroscopic imaging.

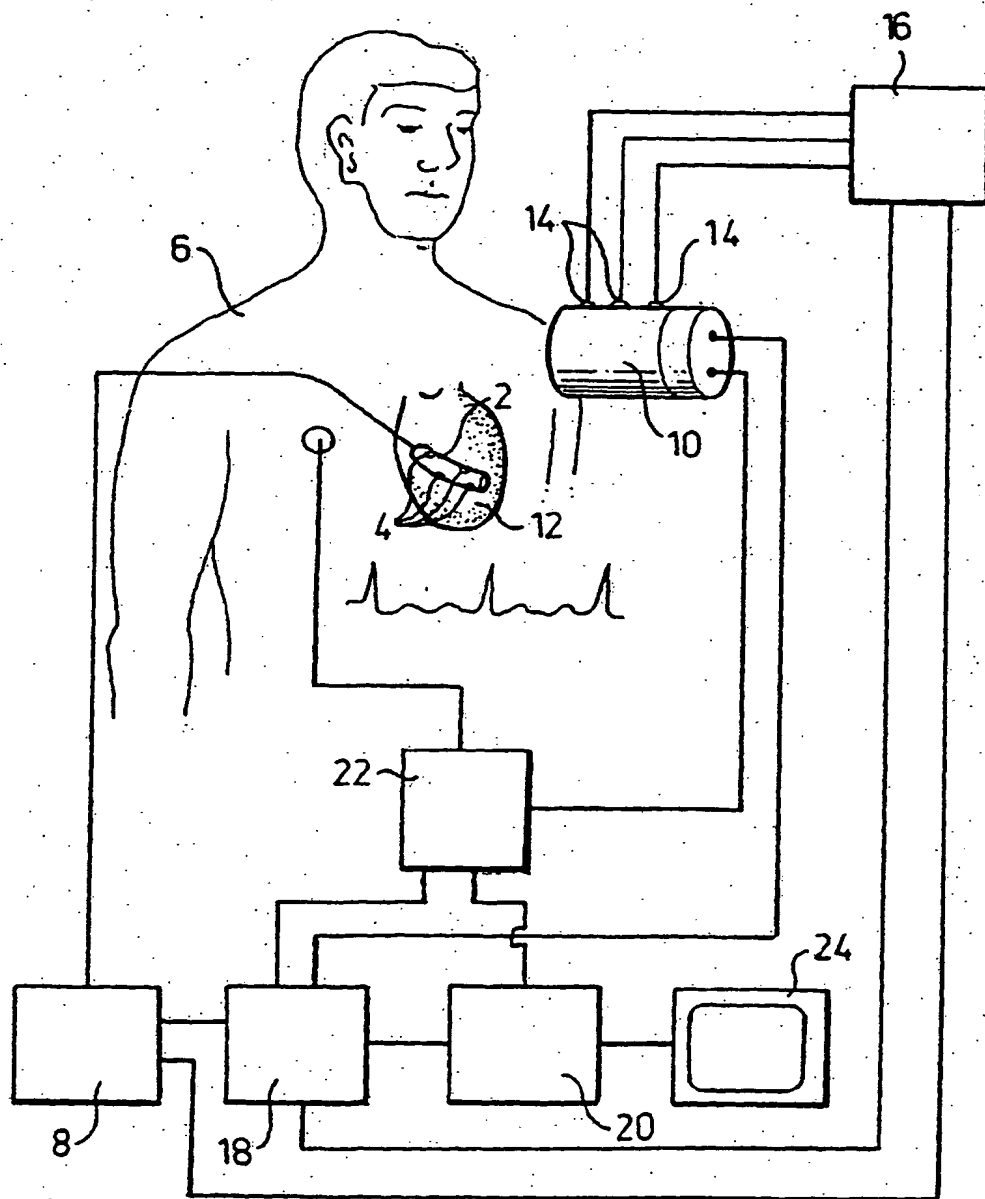
[0025] The invention has been described above as primarily applied to the heart, but the system according to the invention can obviously be used for obtaining images of any internal organ or body structure, including e.g. blood vessels, various abdominal organs etc.

Claims

1. A system for three-dimensional imaging of an internal organ (12) or body structure of patient (6), comprising an ultrasound probe (10) equipped with localization sensors (14), intended for application to the exterior of the patient in order to generate an ultrasonograph of the organ (12) or body structure, a localization unit (16) arranged to determine the position of the probe relative to a reference (2, 4) and an image generating unit (18) arranged to generate a three-dimensional image of the organ from a plurality of ultrasonographs captured with the probe in different positions and from associated information from the localization unit on the position of the probe, characterized in that at least one moveable reference sensor (4) is devised to be placed in a fixed position in relation to the said organ (12) or body structure to be visualized so as to form the said reference.
2. The system according to claim 1, characterized in that the reference sensor (4) is mounted on a reference catheter (2) intended for insertion to a fixed position in the organ (12) or body structure to be visualized.
3. The system according to claim 1 or 2, characterized in that the probe (10) is equipped with at least three separate localization sensors (14).
4. The system according to any of claims 1-3, characterized in that the localization sensors (14) are arranged on the probe (10) in an essentially straight line that, when the probe is applied to the patient (6), is mainly perpendicular to the probe's contact surface with the patient.
5. The system according to claim 4, characterized in that four separate reference sensors (14) are arranged on the reference catheter (2).
6. The system according to any of the preceding

claims, characterized in that each reference and localization sensor (4, 14) has an ultrasound transceiver, and the localization unit (16) is arranged to determine the position of the probe (10), in relation to the reference sensor(s), from signals from the reference and localization sensors.

7. The system according to any of the previous claims, characterized in that the localization unit (16) is also arranged to determine the aiming direction and rotational position of the probe (10), in addition to its position, from signals from the reference and localization sensors (4, 14).
8. The system according to any of the previous claims, characterized in that image storage means (20) are arranged for storing the three-dimensional image of the organ (12).
9. The system according to claim 8, characterized in that an ECG device (22) is arranged to trigger the image generating unit (18) and the said image storage means (20) for storing images from ultrasonographs taken at a specific point in the heart cycle.



BEST AVAILABLE COPY

EP 1 005 835 A1



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 9034

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 97 29709 A (D.E. ACKER ET AL.) 21 August 1997 (1997-08-21) * page 19, line 3 - page 22, line 12 *	1-3,6,7	A61B8/12 A61B8/08
Y	WO 90 13259 A (TOMTEC) 15 November 1990 (1990-11-15)	1,3,5,6	
A	* page 7, line 10 - page 8, line 25 * * page 9, line 9 - page 11, line 16 * * page 13, line 9 - page 14, line 15 *	8,9	
D,Y	WO 98 00060 A (SIEMENS-ELEMA A.B.) 8 January 1998 (1998-01-08)	1,3,5,6	
A	* page 4, line 7 - page 5, line 33 * * page 6, line 34 - page 8, line 10 * * page 14, line 9 - line 32 *	2,7	
A	US 5 197 476 A (C. NOWACKI ET AL.) 30 March 1993 (1993-03-30) * column 1, line 23 - line 68 * * column 3, line 5 - line 46 *	1,3-8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			A61B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 March 2000	Examiner Rieb, K.D.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P/C01)

BEST AVAILABLE COPY

EP 1 005 835 A1

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 99 11 9034

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-03-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9729709 A	21-08-1997	AU 1616697 A	02-09-1997
		AU 1616797 A	02-09-1997
		AU 1616897 A	02-09-1997
		AU 709081 B	19-08-1999
		AU 1958997 A	02-09-1997
		EP 0910300 A	28-04-1999
		WO 9729699 A	21-08-1997
		WO 9729700 A	21-08-1997
		WO 9729682 A	21-08-1997
		AU 711668 B	21-10-1999
		AU 1731597 A	02-09-1997
		AU 2131497 A	02-09-1997
		AU 2275597 A	02-09-1997
		AU 714071 B	16-12-1999
		AU 4218397 A	14-04-1998
		CA 2237992 A	26-03-1998
		EP 0883375 A	16-12-1998
		EP 0910299 A	28-04-1999
		EP 0910278 A	28-04-1999
		EP 0926997 A	07-07-1999
		WO 9729679 A	21-08-1997
		WO 9811840 A	26-03-1998
		WO 9729710 A	21-08-1997
		WO 9729684 A	21-08-1997
		AU 1170197 A	01-08-1997
		AU 712539 B	11-11-1999
		AU 1206697 A	01-08-1997
		AU 1616997 A	02-09-1997
		CA 2242353 A	17-07-1997
		CA 2242356 A	17-07-1997
		EP 0888082 A	07-01-1999
		EP 0888150 A	07-01-1999
		EP 0888086 A	07-01-1999
		WO 9724983 A	17-07-1997
		WO 9725101 A	17-07-1997
		WO 9729701 A	21-08-1997
WO 9013259 A	15-11-1990	DE 3914619 A	08-11-1990
		AT 102807 T	15-04-1994
		DE 58907254 D	21-04-1994
		EP 0470954 A	19-02-1992
		JP 2842911 B	06-01-1999
		JP 7500506 T	19-01-1995
		US 5295486 A	22-03-1994
WO 9800060 A	08-01-1998	EP 0959762 A	01-12-1999

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No: 12/82

EP 1 005 835 A1

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 99 11 9034

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-03-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5197476 A	30-03-1993	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82